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Effect of Integrated Weed Management Practices on Forage Yield and Quality of Lucerne (*Medicago sativa* L.)

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ABSTRACT

A field experiment was conducted to study the effect of integrated weed managemet practices on forage yield and quality of Lucerne (*Medicago sativa* L.) during *rabi* 2008-09. Application of imazethapyr @ 75 g a.i. ha^{-1} at 12 DAS; sowing pure seed of lucerne fb hand weeding at 30 DAS & after each cut and salt (10%) treatment to seeds + imazethapyr @ 75 g a.i.ha^{-1} at 12 DAS in Lucerne were found to be the best weed management practices with significantly higher green fodder, dry fodder and crude protein yields. Further, the use of herbicides viz., pendimethalin or imazethapyr was noted to be harmless for animal consumption as their residues in green fodder degraded completely by the time lucerne was harvested (68 DAS).

Key words : Crude Protein Yield, Dry fodder, Green fodder, Lucerne, Residues

Lucerne is known as green gold of forage crops occupying third position in area and production after sorghum and hybrid napier. It is a proteinaceous rich legume (18-22%) with wide adaptability throughout the world. In India, lucerne is cultivated in an area of 1.0 m ha with a productivity of 60 - 130 t ha^{-1} yr^{-1} of green fodder (Hazra and Sinha, 1996). However, the area under lucerne is fluctuating and the perennial nature of this fodder crop is not fully exploited by farmers due to infestation by weeds. Weeds in lucerne were reported to cause yield losses as high as 95 per cent (Dawson and Rincker, 1982). In recent years, the use of herbicides appears to be an effective approach for control of weeds including *Cuscuta chinesis* during establishment and initial crop growth period of lucerne. The efficacy of pendimethalin and imazethapyr was earlier established to certain extent on control of all weeds in Lucerne (Mahadevappa and Bhanumurthy,2005). Cultural methods like selection of pure seed, 10 per cent salt treatment, state seed bed were also tested in other crops to control weeds including *Cuscuta chinensis*. Besides, lucerne being a forage crop and is harvested at 50 per cent flowering to feed the animals as raw green fodder, it is necessary to study the residual content of above herbicides on animal health. Hence, the present investigation was conducted to study the effect of integrated weed management practices on weed control in lucerne and their corresponding effect on forage production and quality.

MATERIAL AND METHODS

A field experiment was conducted at Student's Farm, College of Agriculture, Rajendranagar, Hyderabad during *rabi* 2008-09. The soil of the experimental field was sandy loam in texture, slightly alkaline in reaction (pH of 7.5) with low organic carbon content (0.5%), low available nitrogen (240.0 kg ha^{-1}), phosphorus (23.5 kg ha^{-1}) and potassium (326.5 kg ha^{-1}) contents. The experiment was laid out in randomized block design with twelve treatments replicated thrice in plots of 4.2 x 4 m size. The treatment included are salt (10%) treatment to seeds of lucerne + hand weeding at 30 DAS and after each cut, salt (10%) treatment to seeds + imazethapyr @ 75g a.i. ha^{-1} at 12 DAS, salt (10%) treatment to seeds + pendimethalin @ 0.5 kg a.i. ha^{-1} at 12 DAS, stale seed bed + hand weeding at 30 DAS, pendimethalin @ 0.5 kg and 0.75 kg a.i.ha^{-1} as PE, imazethapyr @ 75 g and 100 g a.i.ha^{-1} at 12 DAS, pure seed of lucerne + hand weeding at 30 DAS and after each cut, Hand weeding at 30 DAS and after each cut (farmers practice), weedy check and weed free check. A seed rate of 15 kg ha^{-1} was used and seeds were sown with inter row spacing of 30 cm in solid intra row. Uniform dose

of N, P_2O_5 and K_2O @ 30, 80, 40 kg ha^{-1} was applied to all the treatments. Half the recommended dose of nitrogen in the form of urea was applied as basal and the remaining half at 35 DAS. Whereas, P_2O_5 and K_2O were applied as basal in the form of single super phosphate and muriate of potash, respectively. Prophylactic spraying of acephate @ 1.0 g l^{-1} was done against sucking pest complex at 20 DAS and 10 days after I cut. Three cuts of forage were taken. The first cut was taken at 68 DAS, II cut at 36 days after I cut and III cut at 32 days after II cut. Total green fodder, dry fodder, crude protein yields (t ha^{-1}) crude protein % and weed dry weight were noted after each cut of forage. Imazethapyr and pendimethalin residues in lucerne fodder at the time of harvest were estimated by Gas liquid chromatography using electron capture detector (ECD) and the residues in the sample were calculated as –

Concentration of residues in sample (ppm) =
Area of Sample/Area of Standard X
µl std. injected /µl sample injected X
Final volume / wt. of sample.

RESULTS AND DISCUSSION

Forage Yield :

Total green fodder, dry fodder and crude protein yields varied significantly due to different weed management practices. There was identical increase in green fodder, dry fodder and crude protein yields under chemical, cultural and mechanical weed control methods. The total green fodder, dry fodder and crude protein yields of lucerne over three cuts were significantly higher due to application of imazethapyr @ 75 g a.i. ha^{-1} at 12 DAS. However, it was at par to pure seed (Cuscuta free) sowing of lucerne + hand weeding at 30 DAS and after each cut, salt (10%) treatment to seeds + imazethapyr @ 75 g a.i. ha^{-1} at 12 DAS. Application of Imazethapyr @ 100 g a.i. ha^{-1} at 12 DAS was found equivalent to imazethapyr @ 75 g a.i. ha^{-1}, pure seed (Cuscuta free) sowing of lucerne + hand weeding at 30 DAS and after each cut, salt (10%) treatment to seeds + imazethapyr @ 75 g a.i. ha^{-1} at 12 DAS treatments with respect to green fodder yield. On the other hand, crude protein percentage lucerne did not vary to a greater extent among the treatment and it ranged from 17.38 to 21.02%. The results clearly favoured the early post- emereged use of imazethapyr @ 75 g a.i. ha^{-1} at 12 DAS, pure seed sowing of lucerne + hand weeding at 30 DAS and after each cut and salt (10%) treatment to seeds + imazethapyr @ 75 g a.i. ha^{-1} at 12 DAS considering all types of weeds including cuscuta. These treatments resulted in better control of weeds right from crop emergence up to critical period of crop weed competion i.e., 30 DAS which led to efficient utilization of growth resources by the crop plants, eventually higher green fodder, dry fodder and crude protein yield.

Among the herbicides, imazethapyr was found efficient than pendimethalin as it controlled all types of weeds (including *cuscuta*). While pendimethalin controlled grasses and sedges only but could not control broad leaved weeds viz., *Parthenium hysterophorus* which contributed to higher proportion of weed dry weight. Sowing pure seed of lucerne collected from cuscuta free lucerne plants in combination with farmers practice effectively controlled all the weeds and prevented cuscuta infestation there by resulting in higher total green fodder, dry fodder and crude protein yields. This clearly emphasizes the use of cuscuta free lucerne seed as an important cultural practice to prevent cuscuta infestation. The lowest green fodder, dry fodder and crude protein yields (8.569, 2.699 and 0.525 t ha^{-1}) were registered when no control measure was practiced i.e., weedy check which however was on par to farmers practice with hand weeding at 30 DAS and after each cut and sowing on stale seed bed + hand weeding at 30 DAS (Table 1).

Herbicide residues :

Green fodder samples of lucerne collected from herbicide applied plots as I cut were analysed for residues of imazethapyr and pendimethalin. The residues of these herbicides were not detected in lucerne green fodder as both the herbicides degraded completely by the time it was harvested. The recovery of imazethapyr and pendimethalin at 1, 2 ppm levels of fortification were 83,85 and 78,81 per cent respectively. The standard chromatogram graph of imazethapyr and pendimethalin showed the retention time were 5.450, 10.851 minutes (Fig.2) respectively and the limit of detection for both the herbicides was 0.05 mg kg^{-1}. The half life period

Table 1. Green fodder, dry fodder and Crude protein yields (t ha^{-1}) as influenced by Integrated weed management practices in lucerne

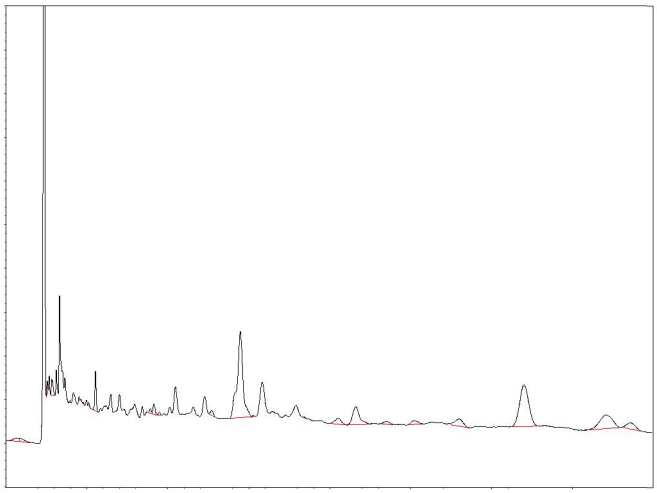
Treatment	Dose g ha^{-1}	Application stage (DAS)	Total Green fodder yield (t ha^{-1})	Total dry fodder yield (t ha^{-1})	Total Crude protein yield (t ha^{-1})	Crude protein (%)	Weed dry weight Kg m^{-2} (AV)
Salt (10 %) treatment to Lucerne seeds before sowing fb farmers practice			18.607	5.847	1.109	19.11	50.15
Salt (10 %) treatment to seeds + Imazethapyr	75	12	29.575	9.108	1.906	21.02	42.92
Salt (10 %) treatment to seeds + Pendimethalin	500	12	26.038	8.245	1.566	19.11	64.00
Stale seed bed + hand weeding at 30 DAS			13.984	4.410	0.834	19.12	73.72
Pendimethalin	500	Pre-emergence	19.689	6.084	1.051	17.38	51.80
Pendimethalin	750	Pre-emergence	23.331	7.155	1.423	20.02	84.01
Imazethapyr	75	12	33.544	10.185	2.116	20.88	45.05
Imazethapyr	100	12	27.671	8.273	1.685	20.47	38.19
Pure seed of Lucerne fb farmers practice (HW at 30 DAS)			30.388	9.391	1.882	20.12	8.28
Farmers practice (Hand weeding) at 30 DAS and after each cut)			12.367	3.842	0.810	20.12	43.03
Weedy check			8.569	2.699	0.525	19.49	154.64
Weed free check			17.081	5.277	1.069	20.37	15.09
S.Em $\pm$			2.030	0.610	0.118		
CD (P = 0.05)			5.954	1.791	0.347		

In weed free check couldnot separated the intacted parasite i.e cuscuta plats with the host plant (Lucerne) hence, the average dry weight of weed higher than that of (T9) Pure seed of Lucerne fb farmers practice (HW at 30 DAS). In weed free check the weed dry weight obtained with cuscuta but in pure seed of Lucerne the cuscuta infestation completely restricted.

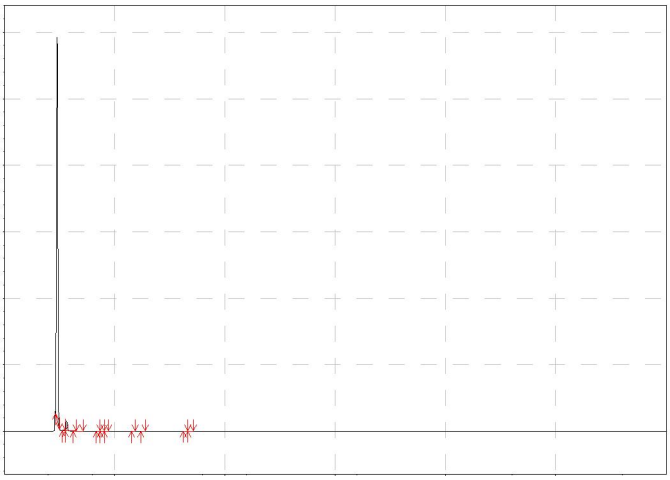
of imazethapyr and pendimethalin is 60 - 90 and 30 days, respectively. So, it is safe to use imazethapyr either @ 75 or 100 g a.i. ha^{-1} and pendimethalin @ 0.5 or 0.75 kg a.i. ha^{-1} (Fig. 1) as their residue did not build up in green fodder to ulter animal consumption. These results are in accordance with Shoba Sondhia Dubey *et al*.(2006) who found that dry onion bulbs were free from pendimethalin residues when applied @ 1 kg a.i. ha^{-1} as PE. From the above result it can be concluded that use of chemical method of weed control with imazethapyr @ 75 g a.i ha^{-1} is the best option for higher green fodder production and quality in lucerne. However, this can be substituted by combination of cultural (pure seed of lucerne) + mechanical (hand weeding at 30 DAS and after each cut) and cultural (10 per cent salt treatment) + chemical method (imazethapyr and pendimethalin). The residues did not found even in T3 (salt (10%) treatment to seeds + pendimethalin @ 0.5 kg a.i. ha^{-1} at 12 DAS) i.e pendimethalin when used as post emergent herbicide also disintegrated at 30 DAS.

Fig : 1 Chromatogram Showing Residual Concentration Of Imazethapyr And Pendimethalin In Lucerne Forage At Harvest

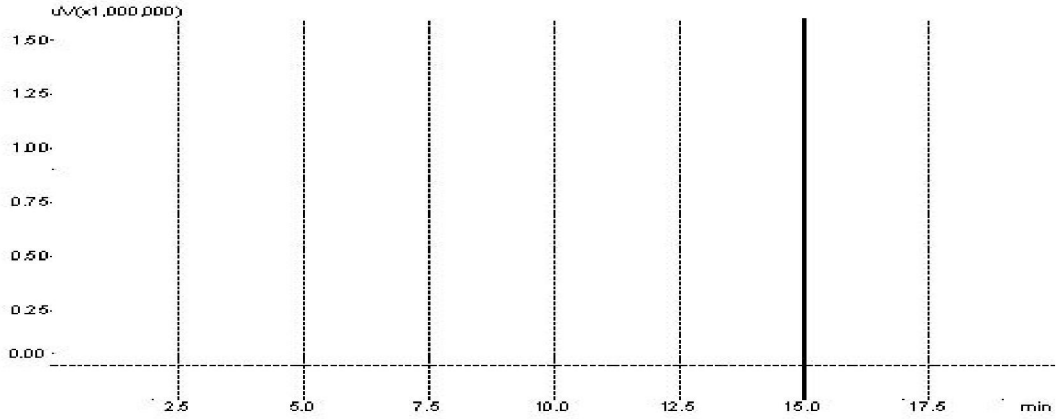
A) Chromatogram Showing No Residues of Imazethaypr @ 100 G Ha^{-1} As Post Emergence



B) Chromatogram Showing No Residues of Imazethaypr @ 75 G Ha^{-1} As Post Emergence



C) Chromotogram Showing No Residues of Pendimethalin @ 0.75 Kg Ha^{-1} As Pre Emergence



d) Chromatogram Showing No Residues of Pendimethalin @ 0.50 Kg Ha^{-1} As Pre Emergence

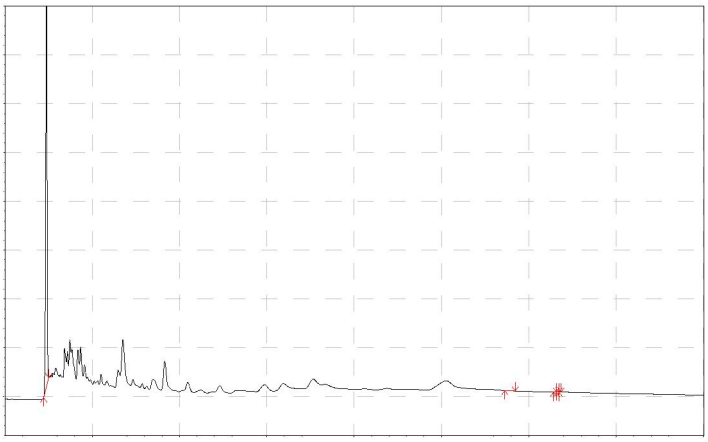
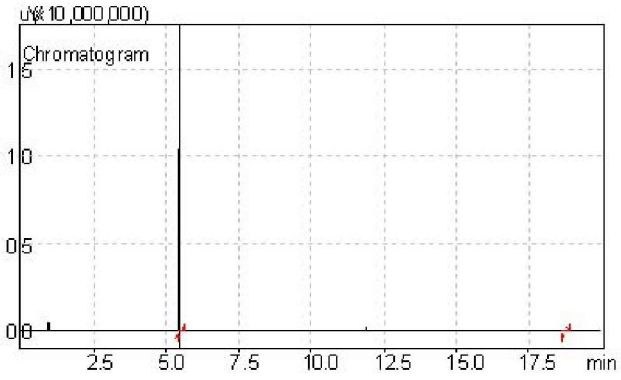
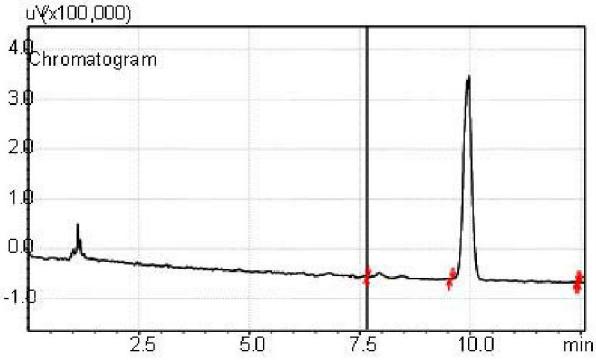


Fig 2. Standard Chromatogram of Imazethapyr and Pendimethalin Using Gas Liquid Chromatography Technique

Imazethapyr 1ppm



Pendimethalin 1ppm



Peak	Retention time	Area	Sample
1	0.501	2762380	n-hexane
2	5.450	54752382	Imazethapyr
3	10.297	1159	"
4.	11.984	29792	"
5.	18.701	1491	"

Peak	Retention time	Area	Sample
1	1.159	5738380	n-hexane
2	10.851	2137476	Pendimethalin
3	11.496	21360	

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